Attitudinal disposition of extension experts towards precision farming in Kwara state, Nigeria

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Abstract

This study assessed the attitude of extension experts in Kwara State towards PA as well as the constraints limiting dissemination of PA information to farmers. Data were obtained from 113 extension experts using a three-stage sampling technique and analysed with descriptive statistics and multiple regression. Results showed that 54% of respondents were male, while 46% were female. The mean age and years of education were 40.41 ± 6.61 years and 15.69 ± 2.85 years respectively, with an average annual income of ₦169,369.37 ± 85,731.60. The findings revealed that 55% of attitudinal statements reflected a positive disposition towards PA, while 45% were negative. A significant positive relationship between respondents' attitudes and selected socio-economic characteristics was observed at p= 5% significant level. The main constraints include unavailability of PA technologies in rural areas ($\bar{x}$ = 2.58), limited availability of PA materials in local languages ($\bar{x}$ = 2.53), farmers' low literacy level ($\bar{x}$ = 2.50), and lack of collaboration among extension stakeholders ($\bar{x}$ = 2.55). It was concluded that most extension experts had favourable attitudes towards PA, but dissemination of PA information is limited by several challenges. The study recommends increased farmer education on PA, improved collaboration among stakeholders, and enhanced access to PA technologies in rural communities.

Key words: Agriculture, precision, attitude, remote-sensing, machine-learning, adoption, farming

Introduction

Nigeria's population is steadily growing, posing a significant threat to the country's food security. This growth is leading to rapid urban and rural community expansion, thereby reducing the availability of agricultural land (cultivable land). [1]

posited that there is synergy between food security and population of the country. This synergy adversely affects the food production system and the food availability. Likewise, the rising cost of agricultural inputs, driven by economic instability, further compounds the problem. Thus, there is an urgent need to maximise the efficient use of the available land and other resources to ensure sufficient food production.

Compounding these challenges is Nigeria's predominantly traditional farming system, which depends on crude tools and outdated methods, resulting in low productivity and inefficient resource use. Most agricultural activities are carried out by smallholder farmers who operate fragmented farm lands with limited financial resources. Household labour, including children, is commonly used, and many farmers cultivate on infertile soils. Furthermore, majority of these farmers have low levels of formal education and limited knowledge of modern farming techniques [2, 3, 4). Consequently, there is a pressing need for farming system(s) that can enhance productivity with minimal resources and labour investment.

One promising farming system is Precision Agriculture (PA) which has been defined by International Society for Precision Agriculture [5] as "a management strategy that gathers, processes and analyzes temporal, spatial and individual plant and animal data and combines it with other information to support management decisions according to estimated variability for improved resource use efficiency, productivity, quality, profitability and sustainability of agricultural production". This farming system incorporates technologies such as GPS, satellite imagery, sensors, and data analytics to enable informed farm-level decision-making. Precision agriculture optimises input use, enhances crop monitoring, and enables timely interventions that increase yields and reduce waste. Built on the principle of producing more with fewer resources, PA can address the rising food demand while promoting sustainable agricultural practices [6, 7, 8].

However, the effective dissemination and adoption of precision agriculture is hinged on the performance of the agricultural extension system [9]. In Nigeria, extension services are responsible for delivering agricultural innovations to farmers, especially smallholders. Currently, Nigeria practices pluralistic extension services which involve the government extension services establishment both at federal and state levels as well as the involvement of private organisations and non – governmental organisations (NGOs). Essentially, the attitude of extension experts plays a critical role in the dissemination of precision agriculture (PA) innovations to farmers. Extension agents are the key facilitators whose opinions strongly shape farming decisions. It is therefore essential for extension agents to have positive attitudes toward innovation in order to facilitate the adoption of new technologies such as PA. [10,11,12] argue that where extension agents have weak behavioural intentions or low self-efficacy to promote precision agriculture, diffusion will be

slow and adoption rates will remain low. Furthermore, when there are inadequate support and encouragement from extension agents, farmers may lose potential yield, savings, and environmental benefits of PA [13]. Unfavourable attitudes of change agents toward new practices (e.g., climate-smart or sustainable technologies) are linked to low participation in promoting them and low farmer uptake [14, 12].

Presently in Nigeria, the potential of PA has not been tapped owing to gap in the awareness among farmers in the country despite the acerbated problems like climate change, unavailability of improved planting materials, land degradation, shortage of adult labour amongst others [15, 16, 17, 18]. More so, limited studies have been carried out on the attitude of extension experts towards precision farming which is essential to the adoption of PA by most farmers. This study, therefore, investigated the disposition of extension experts towards precision agriculture in Kwara State, Nigeria. Specifically, the study examined the socio-economic characteristics of extension experts in Kwara State, their attitude towards PA and the constraints limiting dissemination of PA information to farmers in the study area.

Materials and Methods

Description of the study area

The study was conducted in Kwara State, Nigeria. The State is located in the North-central geopolitical zone of the country with 3,390,330 population. The State is situated on N 8° 58' 0.826" and E 4° 23' 14.658" [19]. The State shares boundaries with Niger, Kogi, Oyo, Ekiti, and Osun states, as well as the republic of Benin. Kwara State economy is based on agriculture with major crops cultivating including maize, sorghum, cassava, millet, yam, and rice. The State has sixteen Local Government Areas which are - Asa, Baruten, Edu, Ekiti, Ifelodun, Ilorin East, Ilorin South, Ilorin West, Irepodun, Isin, Kaiama, Moro, Offa, Oke-Ero, Oyun and Patigi. The State has a number of agricultural extension service provider institute which include – NISPRI, Universities, FADAMA, Kwara State Agricultural Development Project (KWADP) amongst others. There are different ethnic groups in the State which include Yoruba, Nupe, Busa (Bokobaru), Fulani and Bariba (Baatonu). Agriculture remains one of the primary occupations of the people in the State and it employs significant numbers persons.

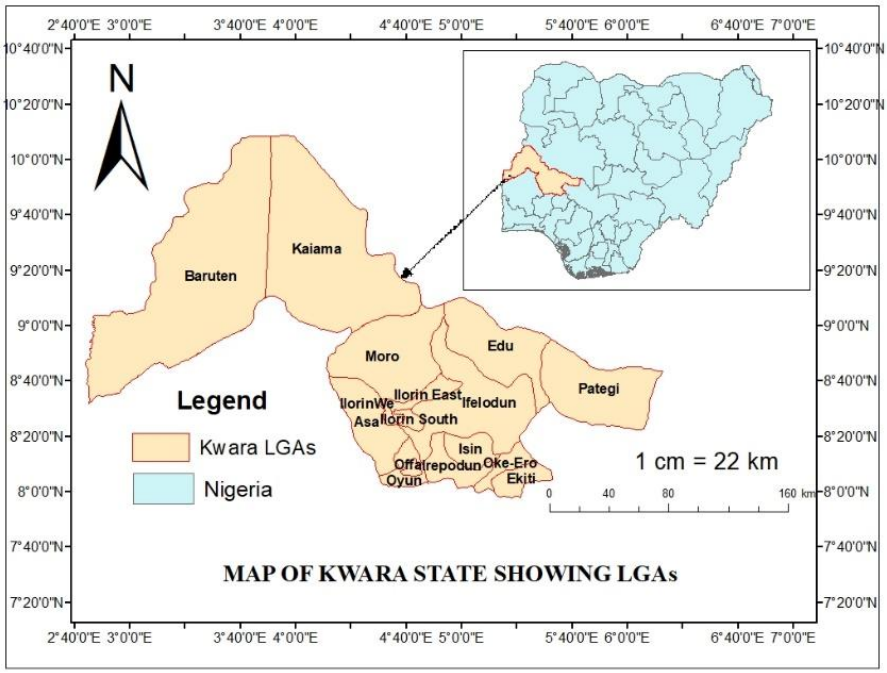

Figure 1: Map of North central showing Kwara State Map
Source: Created with QGIS Software

Sampling procedure and sample size

The population of the study comprised all the extension experts in the study area. 113 out of 172 extension experts were selected using three-stage sampling technique. The first-stage involved purposive selection of agricultural extension service rendering institution in the State. While the second stage involved proportionate selection of 45% of the expect in each of the selected organisation. The third-stage involved random selection of the respondents based on the proportion (KWADP: 60, UNILORIN:27, NSPRI:15, FADAMA:7 and KWASU:4).

Table (1): Summary of Sampling procedure and sample size

Sampling Stage	Technique Used	Institutions	Total Extension Experts	Proportion Used	Number Selected
1st Stage	Purposive	Selection of extension service-rendering institutions in Kwara State	—	—	5 Institutions
2nd Stage	Proportionate	KWADP (ADP)	84	45%	60
3rd Stage	Simple Random	UNILORIN	46	45%	27
		NSPRI	18	45%	15
		FADAMA	16	45%	7
		KWASU	8	45%	4
		Total	172	—	113

Method of Data Collection

Data for the study was collected using open data kit (ODK). The questionnaire was designed based on the objectives of the study. The instrument was validated by agricultural extension experts and it was subjected to test-retest reliability test.

Analytical Techniques

The obtained data were analysed using descriptive and inferential statistics. The dependent variable of the study was attitude. Likert type scale of (SA-SD) was used to determine the attitude of the respondents. It was scored as SA=5, A=4, N=3, D=2, SD=1. Twenty items were raised. The first ten were positively framed while the last ten were negatively framed. The test scores were reversed for the negative framing. That is, SA=1, A=2, N=3, D=4, SD=5. The mean score was generated, and decisions on the statements whether positive or negative were made based on the average mean score. Scores higher than 3.57, an average mean, were considered positive while statement with lower scores were considered negative. Likewise, the constraint was measured using Likert type scale of not a constraint (0), less serious constraint (1) and very serious constraint (2). Ten items were developed to test for the constraints. A score that is higher than the average score was regarded as serious constraint while score below the average was considered as not a serious constraint. In addition, the relationship between socio-economic variables and attitude of the

respondents was tested with multiple regression. It was tested at $p< 0.05$ significant level.

Results and Discussion

Socio-economic characteristics of the respondents

Table 2 reveals that 54% of the respondents were male, while 46% were female. This indicates a slight male predominance within the sampled extension experts. It should be noted that the observed distribution reflects the sample composition and may not perfectly represent the actual gender structure of all extension personnel in the state since respondents were selected using proportionate random sampling across institutions. Nevertheless, the pattern suggests a potential gender imbalance that may have implications for equitable extension service delivery, particularly to women farmers. A similar gender discrepancy was observed by [20] where it was reported that male extension agent accounted for 87.5%.

The Table shows that the mean age of the respondents was 40.41±6.606 years. Most (47.8%) of the respondents were between 31 to 40 years. This indicates that many of the extension experts were young and within active ages. This is in line with the findings of [21, 23, 23] who stated that extension experts are you ng and are expected to be agile and strong to perform the strenuous activities in extension services. The Table shows that 87.6% of the respondents were married while 12.4% were unmarried. Most (54.9%) of the respondents had M.Sc. degree with mean of 15.69±2.851 year of education. The study further revealed that the mean of working experience of the respondents was 9 years. This is an indication that the respondents were relatively young staff of the establishment. It was further showed that majority (92.0%) of the respondents depended solely on civil service. Additionally, the result revealed that most of the extension experts (87.6%) were married while 12.4% were single. This shows that the extension experts were responsible adults with family related responsibilities and that this attribute will most likely make them more responsible. The result reflects a socially stable group, which may influence their income patterns, housing, and long-term planning.

Table (2): Distribution of the respondents based on socio-economic characteristics (n=113)

Variables	Frequency	Percentage	Mean/StD.
Age			
<30	9	8.0	40.41±6.606
31-40	54	47.8	
41-50	39	34.5	
>51	11	9.7	
Gender			

Male Female	61 52	54.0 46.0	
Marital status Unmarried Married	 14 99	 12.4 87.6	
Years of Education Secondary First Degree Post-Graduate studies	 4 47 62	 3.5 41.6 54.9	15.69±2.851
Years of experience 1 – 10 11-20 >20	 82 22 9	 72.6 19.5 8.0	9.25 ± 6.638

Source: Field Survey (2025)

Attitude of extension experts towards the use of precision agriculture

The average mean score of 3.57 was used to determine the respondents' attitudes (positive or negative attitude) towards the use of precision agriculture. Responses with mean value below 3.57 were considered negative attitude while responses with mean value above the average mean were considered positive. The respondents showed a positive attitude towards statement like precision agriculture is essential for sustainable agriculture process ($\bar{x}$ = 3.72), precision agriculture is suitable for both small scale and large-scale farmers ($\bar{x}$ = 3.58), precision farming is useful in climate change mitigation ($\bar{x}$= 4.11), precision agriculture assists in ecosystem management ($\bar{x}$= 4.07), precision farming can be useful in soil fertility management ($\bar{x}$= 3.73).

The findings revealed that the respondent showed negative attitude towards some statements like the cost of precision agriculture outweighs the benefit ($\bar{x}$= 2.36), utilization of precision arming can injure agricultural production ($\bar{x}$ = 3.31), precision farming is only for developed countries ($\bar{x}$ =3.12), precision agriculture contributes to environmental pollution through emission ($\bar{x}$=3.22), and precision farming depends on knowledge of hardware and software ($\bar{x}$= 3.46).

The results revealed that extension experts show a positive attitude towards the use of precision agriculture. This indicates that extension experts were receptive to the use of precision agriculture. From the findings, it can be deduced that the respondent held a largely positive view of precision agriculture, especially with respect to its sustainability, climate mitigation, ecosystem management and

productivity. This implies that the extension experts had positive disposition towards PA and willing to disseminate PA information to farmers as long as the constraints are removed. The findings agree with [24] and [25] who opined that in Nigeria, extension experts had favourable attitude towards work. Despite the positive views, many also agree with contradictory or inaccurate statements, e.g., that traditional methods are more reliable ($\bar{x}$=3.95) and/or that PA is not suitable for mixed cropping ($\bar{x}$=4.30).

Table (3): Attitude of extension experts towards the use of precision agriculture (n=113)

S/N	Statements	SD	D	N	A	SA	Mean	Remark
1	Precision farming is not applicable to mix-cropping system	0	0	30.1	9.7	0.2	4.30	Positive
2	The technology behind precision agriculture is too difficult for farmers to understand	0	0	31.0	12.4	56.6	4.26	Positive
3	Precision farming is useful in climate change mitigation	5.3	4.4	26.5	0	63.7	4.11	Positive
4	Precision farming assists in the ecosystem management	6.2	2.7	30.1	0	61.1	4.07	Positive
5	Precision farming can help farmers identify areas of attention	2.7	8.0	31.9	0.9	56.6	4.01	Positive
6	Optimization of agricultural products is possible through precision farming	4.4	7.1	31.0	O	57.5	3.99	Positive
7	Traditional farming methods are more reliable than precision agriculture	0	0	46.9	11.5	41.6	3.95	Positive
8	Precision farming reduces environmental pollution	7.1	12.4	27.4	0	53.1	3.79	Positive

9	Precision farming can be useful in soil fertility management	5.3	8.8	38.9	0.9	46.0	3.73	Positive
10	Precision Agriculture is essential for sustainable agriculture process	5.3	6.2	31.0	53.1	4.4	3.72	Positive
11	Precision Agriculture is suitable for both small scale and large-scale farmers	22.1	44.2	0	0	49.6	3.58	Positive
12	Precision farming is not practicable in small scale farm	12.4	32.7	0	0	54.9	3.52	Negative
13	Precision farming assists in production cost reduction	12.4	18.6	22.1	0	46.9	3.50	Negative
14	Precision farming depends on knowledge of software and hardware	3.5	15.0	34.5	24.8	22.1	3.46	Negative
15	Risk from agrochemical is limited through precision farming	0	0.9	50.4	24.8	23.9	3.45	Negative
16	Utilisation of precision farming can injure agricultural production	7.1	46.0	0	0	46.0	3.31	Negative
16	Precision farming contributes to environmental pollution through emission	8.0	48.7	0	0	43.4	3.22	Negative
18	Precision farming is only for developed countries	9.7	49.6	0	0	40.7	3.12	Negative
19	The cost of precision agriculture outweighs the benefit	13.3	37.2	49.6	0	0	2.36	Negative
20	Precision is a form of modern technology	48.70	38.1	0	0	13.3	1.91	Negative

Threshold =3.57
Source: Field survey, 2025

Constraints to the dissemination of precision agriculture information to farmers

The average mean of 2.48 was used as the benchmark to determine whether the constraints to the dissemination of precision agriculture were considered serious or not. Statements with a mean score below 2.48 were regarded as not serious constraints, while those above the threshold were considered serious constraints. The findings revealed that poor infrastructure affects the dissemination of precision agriculture information ($\bar{x}$=2.46), farmers' resistance to adopting new agricultural technologies like precision agriculture ($\bar{x}$=2.44), language and communication barriers between extension workers and farmers ($\bar{x}$=2.27), and farmers' perception of precision agriculture as irrelevant to small-scale farming needs ($\bar{x}$=2.21) were rated as not serious constraints. This suggests that, although these challenges exist, they are not the most significant factors limiting the promotion of precision agriculture.

On the other hand, limited government support and policies hindering the promotion of precision agriculture ($\bar{x}$=2.59), high costs associated with organising training programmes ($\bar{x}$=2.72), limited availability and accessibility of precision agriculture technologies in rural areas ($\bar{x}$=2.58), farmers' low literacy level affecting comprehension ($\bar{x}$=2.53), and limited availability of precision agriculture materials in local languages ($\bar{x}$=2.50) were identified as serious constraints. These findings highlight that systemic and institutional barrier, particularly, policy, cost, accessibility, literacy, and localised training resources constitute the major obstacles to effective dissemination of precision agriculture. Hence, the findings revealed that the most significant obstacles to PA dissemination were systemic (policy, funding, accessibility, and literacy) rather than farmers' attitudes or perceptions. The finding is in line with the observation of [15, 26, 27, 28].

Table (4): Constraints to the dissemination of precision agriculture information to farmers

Constraints	Not a constraint %	Less serious constraint %	Very serious constraint %	Mean	Remark
1. Limited government support and policies hinder the promotion of Precision Agriculture.	10.6	19.5	69.9	2.59	Serious
2. High costs associated with organizing	2.7	23.0	74.3	2.72	Serious

training programs on Precision Agriculture create barriers to dissemination.					
3. Precision Agriculture technologies are not readily available or accessible in rural areas.	10.6	21.2	68.1	2.58	Serious
4. Farmers' low literacy level affects the comprehension of precision agriculture concept	7.1	32.7	60.0	2.53	Serious
5. Limited availability of precision agriculture materials in local languages	8.0	33.6	58.4	2.50	Serious
6. Lack of collaboration between extension organisation	7.1	31.0	61.9	2.55	Serious
7. Poor infrastructure affects the dissemination of Precision Agriculture information.	12.4	28.3	59.3	2.46	Not serious
8. Farmers are resistant to adopting new agricultural technologies like Precision Agriculture.	10.7	34.5	54.9	2.44	Not serious
9. Language and communication barriers between extension workers and farmers limit the effectiveness of information dissemination.	15.0	42.5	42.5	2.27	Not serious

10.Farmers perceive Precision Agriculture as irrelevant to the small-scale farming needs.	23.0	32.7	44.2	2.21	Not serious

Source: Field survey (2025); Threshold=2.48

Hypothesis testing

Relationship between the socio-economic characteristics of the extension experts and their attitude towards precision agriculture

A multiple regression analysis was conducted to examine the relationship between respondents' attitudes and selected socio-economic variables. The results revealed an R value of 0.428, indicating a weak but positive correlation between the independent variables and the dependent variable. The R^2 value of 0.184 suggests that 18.4% of the variation in respondents' attitudes was explained by the socio-economic variables included in the model.

The analysis further showed that main source of income ($p = 0.022$), years of experience ($p = 0.002$), and marital status ($p = 0.050$) were statistically significant predictors of attitude at the 5% level. In contrast, years of education ($p = 0.165$), gender ($p = 0.688$), and types of organisations ($p = 0.952$) were not significant predictors.

Overall, the regression model was statistically significant ($F(7, 101) = 3.243$, $p < 0.05$). This indicates that the socio-economic variables jointly influenced respondents' attitudes. Therefore, the null hypothesis (H_0), which stated that socio-economic variables have no significant influence on attitude, is rejected.

Table (5): Regression analysis between socio-economic characteristics and attitude

Coefficients					
Model		**Unstandardized Coefficients**		**Standardized Coefficients**	**Sig.**
		B	**Std. Error**	**Beta**	
1	**(Constant)**	47.633	10.297		.000
	Years of Education	0.637	0.395	0.161	.110

	Main source of income	-9.040	3.877	-0.218	.022
	Monthly income (Naira)	-2.185E-6	0.000	-0.129	.167
	Years of experience in the work	-0.539	0.173	-0.311	.002
	Type of Organization	0.056	0.921	0.006	.952
	Gender_ Dummy	-0.849	2.108	-0.037	.688
	Married_ Dummy	-6.796	3.419	-0.186	.050
a. Dependent Variable: Merge_Attitude $R = 0.428$, $R^2 = 0.184$, Adj. $R^2 = 0.127$, $F_{(7,101)} = 3.243$, $P = 0.004$					

Conclusion and recommendations

This study assessed the attitude of extension expert towards precision agriculture (PA) as well as the constraints hindering the dissemination of its information to smallholder farmers in Kwara State, Nigeria. The findings revealed that the respondents displayed a favourable attitude towards precision agriculture. However, there are numbers of constraints hindering the dissemination of its information to the farmers which include the perception that PA is irrelevant to smallholder farmers, unavailability of precision agricultural technologies in rural areas, low literacy level amongst farmers etcetera. Similar, it was revealed that the attitude of the extension experts is influenced by source of income, years of experience and marital status. It is therefore recommended that government agencies should organise sensitization workshop on precision agriculture for farmers through their associations to educate them on precision agriculture. Likewise, precision agriculture equipment should be made available in the rural areas to stimulate the uses amongst rural farmers. In addition, as evidenced from the findings, addressing government support, cost reduction, access to technologies, and localised training materials would yield the greatest improvement in promoting PA among farmers.

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